

CLAIMS

What is claimed is:

1. A power regulation system coupled to an AC power source providing an input voltage between a first node and a second node, comprising:
 - a. a first transformer, comprising:
 - i. a winding having a first end and a second end adapted for receiving the input voltage from the AC power source, wherein the second end is electrically coupled to the second node; and
 - ii. a movable wiper arm having a wiper, an output node and a body therebetween, wherein the movable wiper arm is movable continuously between the first end and the second end of the winding so that a control voltage is generated between the output node and the second end;
 - b. a second transformer, comprising:
 - i. a primary coil having a first end and a second end adapted for receiving the control voltage from the first transformer, wherein the second end is electrically coupled to the second node; and
 - ii. a secondary coil having a first end and a second end adapted for outputting an output voltage, wherein the first end is electrically coupled to the first node,wherein the primary coil and secondary coil are electromagnetically coupled to each other and so arranged that when the control voltage from the first transformer is applied to the first end and the second end of the primary coil, the output voltage is generated between the first end and the second end of the secondary coil;
wherein the output voltage is substantially 180° out of phase from the input voltage so as to continuously generate between the first end of the

secondary coil and the second node an effective voltage that is less than the input voltage;

- c. a series contactor having a first end and a second end, wherein the first end is electrically coupled to the first node;
- d. a shunt contactor having a first end and a second end, wherein the first end is electrically coupled to the first end of the primary coil and the second end is electrically coupled to the second end of the primary coil, respectively;
- e. a first circuit breaker electrically coupled between the first end of the winding of the first transformer and the second end of the series contactor; and
- f. a second circuit breaker electrically coupled between the output node of the first transformer and the first end of the primary coil of the second transformer.

2. The system of claim 1, further comprising:

- a. a driver engaging the movable wiper arm through the body of the movable wiper arm; and
- b. a controller, in control communication with the driver, causing the driver to move the movable wiper arm to a selected position between the second end and the first end of the winding, so that a control voltage with a selected value is generated between the output node and the second end of the winding.

3. The system of claim 1, wherein the first transformer is a variable autotransformer having a capacity of output voltage ranging from 0 volts to approximately 220% of the input voltage.

4. The system of claim 1, wherein the second transformer is a buck transformer.
5. The system of claim 4, wherein the primary coil and secondary coil of the buck transformer each has a polarity, and the polarity of the primary coil being reversed from the polarity of the secondary coil.
6. The system of claim 5, wherein the buck transformer is a toroidal transformer.
7. The system of claim 6, wherein the toroidal transformer has a ratio of 4:1 between the winding of the primary coil to the winding of the secondary coil.
8. The system of claim 1, wherein the series contactor has an open state and a closed state, the shunt contactor has an open state and a closed state, and the series contactor and the shunt contactor are arranged in the system such that when the series contactor is in the open state, the shunt contactor will be in the closed state, and vice versa.
9. The system of claim 8, wherein the series contactor is a normally open contactor and the shunt contractor is a normally closed contactor.
10. The system of claim 9, wherein the series contactor and the shunt contactor are configured such that the series contactor is in the closed state and the shunt contactor is in the open state in a normal condition, and the series contactor is in the open state and the shunt contactor is in the closed state in an alarm condition, so that the system outputs an effective voltage that is less than the input voltage in the normal condition, and isolates the first transformer and returns a line voltage in the alarm condition.

11. A power regulation system coupled to a three-phase AC power source, each phase providing an input voltage related to neutral, respectively, comprising:
on each phase,
- a. a first transformer, comprising:
 - i. a winding having a first end and a second end adapted for receiving the input voltage from the phase, wherein the second end is electrically coupled to neutral; and
 - ii. a movable wiper arm having a wiper, an output node and a body therebetween, wherein the movable wiper arm is movable continuously between the first end and the second end of the winding so that a control voltage is generated between the output node and the second end;
 - b. a second transformer, comprising:
 - i. a primary coil having a first end and a second end adapted for receiving the control voltage from the first transformer, wherein the second end is electrically coupled to neutral; and
 - ii. a secondary coil having a first end and a second end, wherein the first end is electrically coupled to the phase;wherein the primary coil and secondary coil are electromagnetically coupled to each other and so arranged that when the control voltage from the first transformer is applied to the first end and the second end of the primary coil, an output voltage is generated between the first end and the second end of the secondary coil;
wherein the output voltage is substantially 180° out of phase from the input voltage so as to continuously generate between the first end of the secondary coil and neutral an effective voltage that is less than the input voltage;
 - c. a series contactor having a first end and a second end, wherein the first end is electrically coupled to the phase;

- d. a shunt contactor having a first end and a second end, wherein the first end is electrically coupled to the first end of the primary coil and the second end is electrically coupled to the second end of the primary coil, respectively;
 - e. a first circuit breaker electrically coupled between to the first end of the winding of the first transformer and the second end of the series contactor; and
 - f. a second circuit breaker electrically coupled between the output node of the first transformer and the first end of the primary coil of the second transformer.
12. The system of claim 11, further comprising:
- a. a driver engaging the movable wiper arm through the body of the movable wiper arm of the first transformer on the phase; and
 - b. a controller, in control communication with the driver, causing the driver to move the movable wiper arm to a selected position between the second end and the first end of the winding, so that a control voltage with a selected value is generated between the output node and the second end of the winding of the first transformer on the phase.
13. The system of claim 12, wherein the controller is in control communication with each driver.
14. The system of claim 11, wherein the first transformer on each phase is a variable autotransformer having a capacity of output voltage ranging from 0 volts to approximately 220% of the input voltage.
15. The system of claim 11, wherein the second transformer on each phase is a buck transformer.

16. The system of claim 15, wherein the primary coil and secondary coil of the buck transformer each has a polarity, and the polarity of the primary coil being reversed from the polarity of the secondary coil.
17. The system of claim 16, wherein the buck transformer is a toroidal transformer.
18. The system of claim 17, wherein the toroidal transformer has a ratio of 4:1 for the winding of the primary coil to the winding of the secondary coil.
19. The system of claim 11, wherein, on each phase, the series contactor has an open state and a closed state, the shunt contactor has an open state and a closed state, and the series contactor and the shunt contactor are arranged in the system such that when the series contactor is in the open state, the shunt contactor will be in the closed state, and vice versa.
20. The system of claim 19, wherein the series contactor is a normally open contactor and the shunt contractor is a normally closed contactor on each phase.
21. The system of claim 20, wherein the series contactor and the shunt contactor on each phase are configured such that the series contactor is in the closed state and the shunt contactor is in the open state in a normal condition, and the series contactor is in the open state and the shunt contactor is in the closed state in an alarm condition, so that the system outputs an effective voltage that is less than the input voltage in the normal condition, and isolates the first transformer and returns a line voltage in the alarm condition.

22. A power regulation system coupled to a multi-phase AC power source, each phase providing an input voltage related to neutral, respectively, comprising: on each phase,
- a. a first transformer, comprising:
 - i. a winding having a first end and a second end adapted for receiving the input voltage from the phase, wherein the second end is electrically coupled to neutral; and
 - ii. a movable wiper arm having a wiper, an output node and a body therebetween, wherein the movable wiper arm is movable continuously between the first end and the second end of the winding so that a control voltage is generated between the output node and the second end;
 - b. a second transformer, comprising:
 - i. a primary coil having a first end and a second end adapted for receiving the control voltage from the first transformer, wherein the second end is electrically coupled to neutral; and
 - ii. a secondary coil having a first end and a second end, wherein the first end is electrically coupled to the phase;wherein the primary coil and secondary coil are electromagnetically coupled to each other and so arranged that when the control voltage from the first transformer is applied to the first end and the second end of the primary coil, an output voltage is generated between the first end and the second end of the secondary coil;
wherein the output voltage is substantially 180° out of phase from the input voltage so as to continuously generate between the first end of the secondary coil and neutral an effective voltage that is less than the input voltage;

- c. a series contactor having a first end and a second end, wherein the first end is electrically coupled to the phase;
 - d. a shunt contactor having a first end and a second end, wherein the first end is electrically coupled to the first end of the primary coil and the second end is electrically coupled to the second end of the primary coil, respectively;
 - e. a first circuit breaker electrically coupled between the first end of the winding of the first transformer and the second end of the series contactor; and
 - f. a second circuit breaker electrically coupled between the output node of the first transformer and the first end of the primary coil of the second transformer.
27. The system of claim 22, further comprising:
- a. a driver engaging the movable wiper arm through the body of the movable wiper arm of the first transformer on the phase; and
 - b. a controller, in control communication with the driver, causing the driver to move the movable wiper arm to a selected position between the second end and the first end of the winding, so that a control voltage with a selected value is generated between the output node and the second end of the winding of the first transformer on the phase.
24. The system of claim 23, wherein the controller is in control communication with each driver.
25. The system of claim 22, wherein the first transformer on each phase is a variable autotransformer having a capacity of output voltage ranging from 0 volts to approximately 220% of the input voltage.

26. The system of claim 22, wherein the second transformer on each phase is a buck transformer.
27. The system of claim 26, wherein the primary coil and secondary coil of the buck transformer each has a polarity, and the polarity of the primary coil being reversed from the polarity of the secondary coil.
28. The system of claim 27, wherein the buck transformer is a toroidal transformer.
29. The system of claim 28, wherein the toroidal transformer has a ratio of 4:1 for the winding of the primary coil to the winding of the secondary coil.
30. The system of claim 26, wherein, on each phase, the series contactor has an open state and a closed state, the shunt contactor has an open state and a closed state, and the series contactor and the shunt contactor are arranged in the system such that when the series contactor is in the open state, the shunt contactor will be in the closed state, and vice versa.
31. The system of claim 30, wherein the series contactor is a normally open contactor and the shunt contractor is a normally closed contactor on each phase.
32. The system of claim 31, wherein the series contactor and the shunt contactor on each phase are configured such that the series contactor is in the closed state and the shunt contactor is in the open state in a normal condition, and the series contactor is in the open state and the shunt contactor is in the closed state in an alarm condition, so that the system outputs an effective voltage that is less than the input voltage in the normal condition, and isolates the first transformer and returns a line voltage in the alarm condition.